

Appl. No.: 09/822,942  
Amdt. Dated: November 17, 2003  
Reply to Office Action of: July 18, 2003

**Amendments to the Claims:**

This listing of claims will replace all prior versions, and listings, of claims in the application:

**Listing of Claims:**

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**Claims 1-2 (Canceled)**

**Claim 3 (Withdrawn):** A friction reducing ship, that reduces frictional resistance by ejecting gas bubbles on a submerged surface of a ship body, comprising a bubble generation apparatus for generating micro-bubbles by creating a negative pressure state in a portion of water admitted from a water intake opening provided below a waterline in a bow section of the ship body so as to eject atmospheric air into the water and discharging the micro-bubbles together with the water to a water discharge opening provided in a bottom section of ship.

**Claim 4 (Withdrawn):** A friction reducing ship, that reduces frictional resistance by ejecting gas bubbles on a submerged surface of a ship body, comprising:  
a water transport passage provided on an external hull plate so as to extend from a water intake opening provided below a waterline in a bow section of the ship

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7 body to a water discharge opening provided in a bottom  
8 section of the ship body, and having an air discharge  
9 opening disposed partway along the passage;

10 an air transport passage extending from above the  
11 water to the air discharge opening; and

12 a gas ejection member protruding toward an inner  
13 side of the water transport passage and provided in such a  
14 way to cover the air discharge opening having a gas  
15 ejection opening; wherein

16 the air discharge opening is situated in a  
17 location such that a hydrostatic pressure at the air  
18 discharge opening is negative with respect to an  
19 atmospheric pressure existing above the water.

1 **Claim 5 (Withdrawn):** A friction reducing ship  
2 according to one of claim 3 or 4, wherein the water  
3 discharge opening in the bottom section is located in a  
4 widthwise center in the vicinity of the bow section of the  
5 ship body.

1 **Claim 6 (Withdrawn):** A method for reducing  
2 frictional resistance of a ship body by creating a negative  
3 pressure state in a portion of water admitted from a water  
4 intake opening provided in a bow section of the ship body

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5 below a waterline so as to generate micro-bubbles by  
6 ejecting atmospheric air into the water and discharging the  
7 micro-bubbles together with the water to a water discharge  
8 opening provided in a bottom section of the ship body.

1           **Claim 7 (Withdrawn):** A method according to claim 6,  
2 wherein the water discharge opening in the bottom section  
3 is located in a widthwise center in the vicinity of the bow  
4 section of the ship body.

1           **Claim 8 (Currently amended):** A method for reducing  
2 frictional resistance of a ship body by  
3           ejecting gas bubbles on a surface of the ship  
4 body submerged in water by creating in the water a negative  
5 pressure region having a pressure lower than a pressure in  
6 a gaseous space, resulting from the ship body cruising  
7 through a body of the water, ~~and~~  
8           directing a gas from the gaseous space to the  
9 negative pressure region in the water, ~~and~~  
10           ~~forming a water flow at the negative pressure~~  
11 ~~region having locally severe vortices~~  
12           exerting inertial force on the gas bubbles at the  
13 negative region in a direction so as to detach the bubbles

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14 from a gas/liquid interface by providing the gas/liquid  
15 interface at a smoothly curved water passage,  
16 wherein the gas in the gaseous space is  
17 substantially at atmospheric pressure.

1 **Claim 9 (Currently amended):** A friction reducing  
2 ship, that reduces frictional resistance by ejecting gas  
3 bubbles on a submerged surface of a ship body, comprising:  
4 a negative pressure forming section for creating  
5 a negative pressure region in water having a lower pressure  
6 relative to a gaseous space;  
7 a fluid guiding passage for directing a gas from  
8 the gaseous space to the negative pressure region; and  
9 a detaching promotion section for ~~forming a water~~  
10 ~~flow at the negative pressure region having locally severe~~  
11 ~~vortices~~ exerting inertial force on the gas bubbles at the  
12 negative region in a direction so as to detach the bubbles  
13 from a gas/liquid interface by providing the gas/liquid  
14 interface at a smoothly curved water passage,  
15 wherein the gas in the gaseous space is  
16 substantially at atmospheric pressure.

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2           **Claim 10 (Previously presented):** A friction reducing  
3 ship according to claim 9, wherein the negative pressure  
4 forming section is comprised by a wing protruding into the  
5 water from the submerged surface of the ship body; struts  
6 for supporting the wing; a flow guiding body disposed on a  
ship side of the wing.

1           **Claim 11 (Previously presented):** A friction reducing  
2 ship according to claim 10, wherein the detaching promotion  
3 section is comprised by the wing on a side of the ship body  
4 so as to have a -shape, and the flow guiding body formed so  
5 as to follow a shape of the wing.

1           **Claim 12 (Withdrawn):** A friction reducing ship, that  
2 reduces frictional resistance by ejecting gas bubbles on a  
3 submerged surface of a ship body, comprising:  
4           a negative pressure forming section protruding  
5 from the submerged surface for creating a negative pressure  
6 region in a water relative to a gaseous space;  
7           a discharge opening for ejecting the gas bubbles  
8 towards the negative pressure region in the water;  
9           a fluid passage having one end open to the  
10 gaseous space and having other end open in the water by way

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11 of the discharge opening so as to direct a gas from the  
12 gaseous space into the water; wherein  
13 the discharge opening is disposed on an inclined  
14 surface inclined at an angle to the submerged surface of  
15 the ship body.

1 **Claim 13 (Withdrawn):** A friction ship according to  
2 claim 12, wherein the inclined surface is disposed in a  
3 depression provided on a submerged surface of a ship body  
4 to extend from an inner location to an outer location of  
5 the depression.

1 **Claim 14 (Currently amended):** A friction reducing  
2 ship, that reduces frictional resistance by ejecting gas  
3 bubbles on a submerged surface of a ship body, comprising:  
4 a negative pressure forming section protruding  
5 from the submerged surface for creating a negative pressure  
6 region in a water relative to a gaseous space;  
7 a detaching promotion section for ~~forming a water~~  
8 ~~flow at the negative pressure region having locally severe~~  
9 ~~vortices exerting inertial force on the gas bubbles at the~~  
10 negative region in a direction so as to detach the bubbles  
11 from a gas/liquid interface by providing the gas/liquid  
12 interface at a smoothly curved water passage;

13 a discharge opening disposed in a rear of the  
14 negative pressure forming section for ejecting gas bubbles  
15 towards the negative pressure region in the water;

16 a fluid passage having one end open to the  
17 gaseous space and having ~~other~~ another end open in the  
18 water by way of the discharge opening so as to direct a gas  
19 from the gaseous space into the water; and

20 a gas supply apparatus for supplying the gas  
21 towards the negative pressure region,

22 wherein the gas in the gaseous space is  
23 substantially at atmospheric pressure.

1 **Claim 15 (Currently amended):** A method for reducing  
2 frictional resistance by

3 ejecting gas bubbles on a submerged surface of a  
4 ship body by creating in a water a negative pressure region  
5 having a pressure lower than the pressure in a gaseous  
6 space, ~~forming a water flow at the negative pressure region~~  
7 ~~having locally severe vortices,~~ resulting from the ship  
8 body cruising through a body of the water, and

9 exerting inertial force on the gas bubbles at the  
10 negative region in a direction so as to detach the bubbles  
11 from a gas/liquid interface by providing the gas/liquid  
12 interface at a smoothly curved water passage,

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13 directing a gas from the gaseous space to the  
14 negative pressure region in the water so as to eject the  
15 gas bubbles into the body of the water, and  
16 supplying the gas to the negative pressure region  
17 by using a ~~specific~~ gas supply apparatus,  
18 wherein the gas in the gaseous space is  
19 substantially at atmospheric pressure.

1 **Claim 16 (Currently amended):** A method for reducing  
2 frictional resistance by  
3 ejecting gas bubbles on a submerged surface of a  
4 ship body by creating in a water a negative pressure region  
5 having a pressure lower than the pressure in a gaseous  
6 space, resulting from the ship body cruising through a body  
7 of the water,  
8 ~~forming a water flow at the negative pressure~~  
9 ~~region having locally severe vortices~~  
10 exerting inertial force on the gas bubbles at the  
11 negative region in a direction so as to detach the bubbles  
12 from a gas/liquid interface by providing the gas/liquid  
13 interface at a smoothly curved water passage, and  
14 directing a gas from the gaseous space to the  
15 negative pressure region in the water, and



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generating a circulating flow of the water by  
17 using a wing to expand the negative pressure region,  
18 wherein the gas in the gaseous space is  
19 substantially at atmospheric pressure.

1 **Claim 17 (Currently amended):** A friction reducing  
2 ship, that reduces frictional resistance by ejecting gas  
3 bubbles on a submerged surface of a ship body, comprising:  
4 a negative pressure forming section protruding  
5 from the submerged surface for creating a negative pressure  
6 region in a water relative to a gaseous space;  
7 a detaching promotion section for ~~forming a water~~  
8 ~~flow at the negative pressure region having locally severe~~  
9 ~~vortices~~ exerting inertial force on the gas bubbles at the  
10 negative region in a direction so as to detach the bubbles  
11 from a gas/liquid interface by providing the gas/liquid  
12 interface at a smoothly curved water passage;  
13 a discharge opening disposed in a rear of the  
14 negative pressure forming section for ejecting the gas  
15 bubbles towards the negative pressure region in the water;  
16 a fluid passage having one end open to the  
17 gaseous space and having other end open in the water by way  
18 of the discharge opening so as to direct a gas from the  
19 gaseous space into the water;

wherein the negative pressure forming section is  
provided with a wing shaped component whose cross sectional  
shape is formed in a wing shape; and  
wherein the gas in the gaseous space is  
substantially at atmospheric pressure.

**Claim 18 (Original):** A friction reducing ship  
according to claim 17, wherein the wing shaped component is  
disposed so as to generate an uplifting force.

**Claim 19 (Withdrawn):** A friction reducing ship, that  
reduces frictional force by ejecting gas bubbles on a  
submerged surface of a ship body, comprising:

a discharge opening disposed on the submerged  
surface for ejecting the gas bubbles into a water;

a fluid passage having one end open to the  
gaseous space and have other end open in the water by way  
of the discharge opening so as to direct a gas from the  
gaseous space into the water; wherein

at least a portion of the fluid passage is  
comprised by component members to form outer shell of the  
ship body.

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**Claim 20 (Withdrawn):** A friction reducing ship  
according to claim 19, wherein at least a portion of the  
component member forming the fluid passage comprise a  
reinforcing component member of the ship body.

**Claim 21 (Withdrawn):** A friction reducing ship  
according to one of claim 19 or 20, wherein the fluid  
passage is divided into a plurality of passages.

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